

INV. TITLE: FULLY ARTICULATED AND COMPREHENSIVE AIR AND FLUID DISTRIBUTION, METERING, AND CONTROL METHOD AND APPARATUS FOR PRIMARY MOVERS, HEAT EXCHANGERS, AND TERMINAL FLOW DEVICES.

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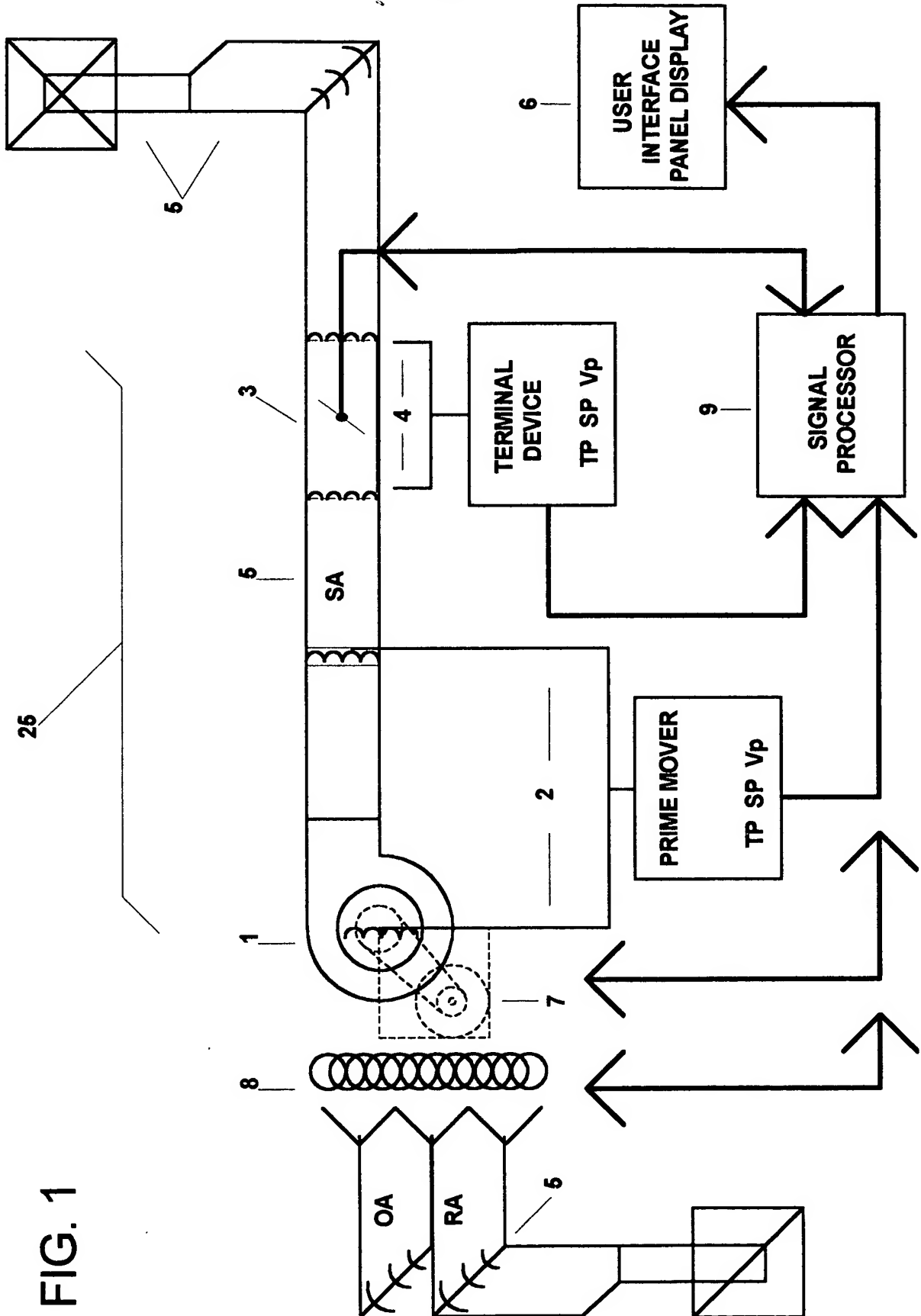
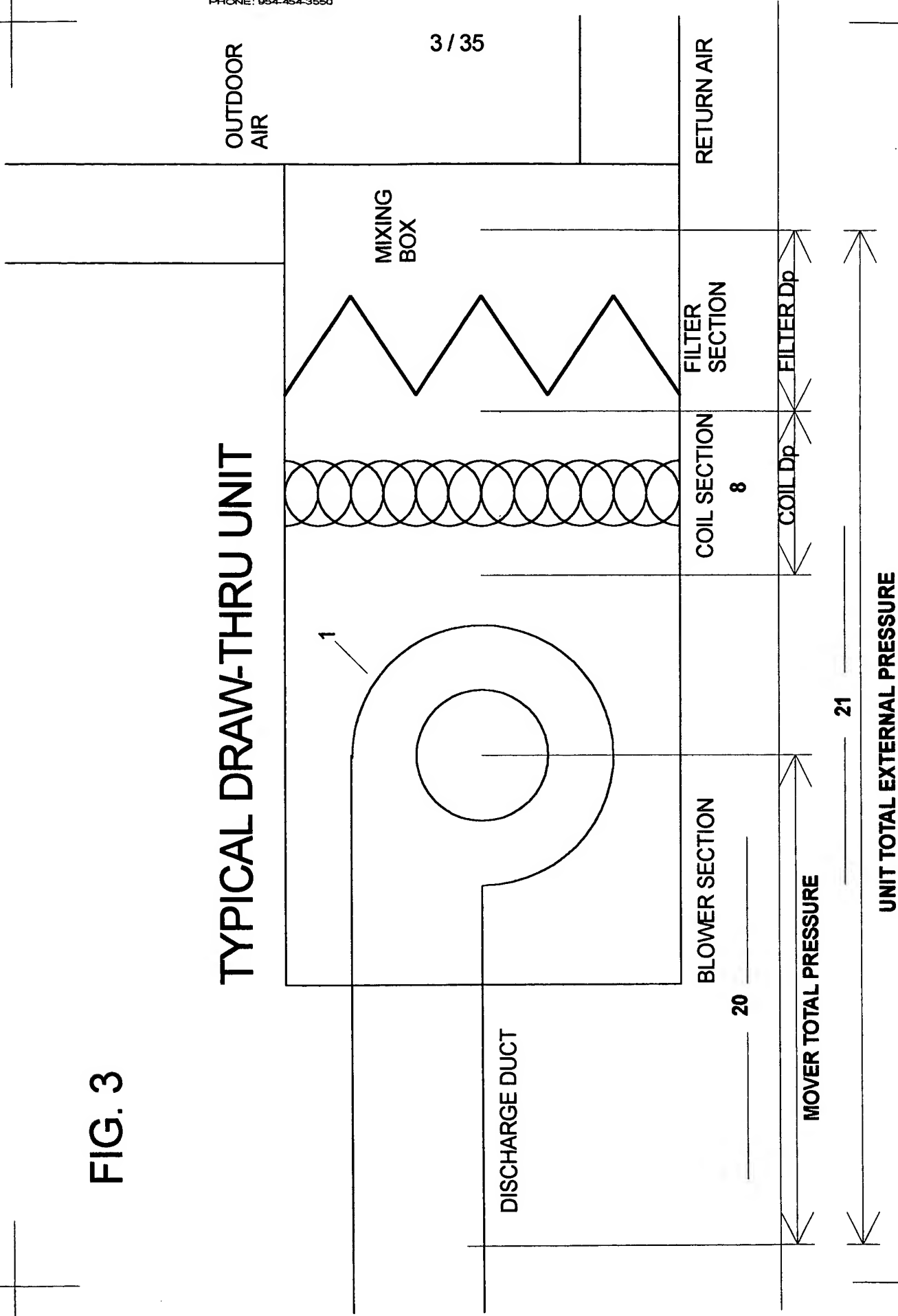


FIG. 1

FIG. 3



TRADITIONAL FAN PERFORMANCE CURVES

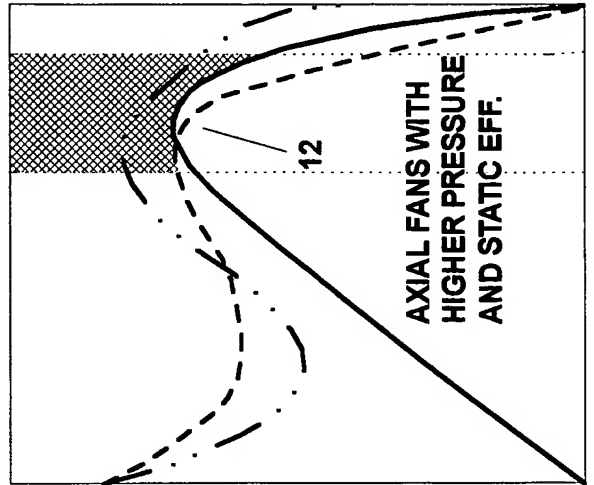
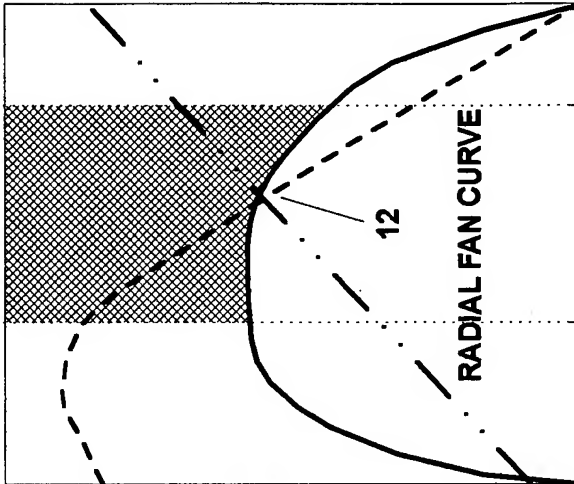
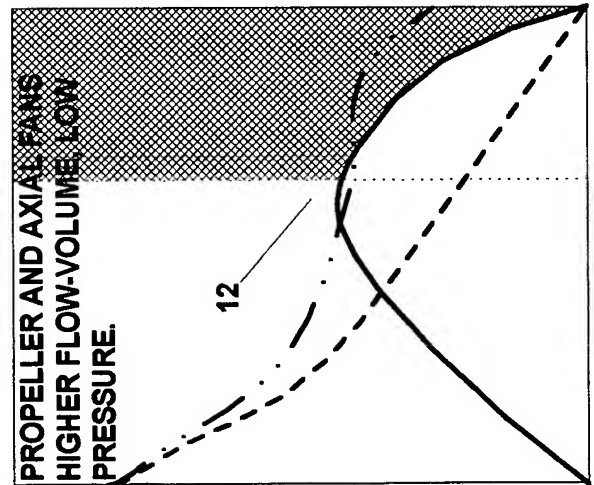
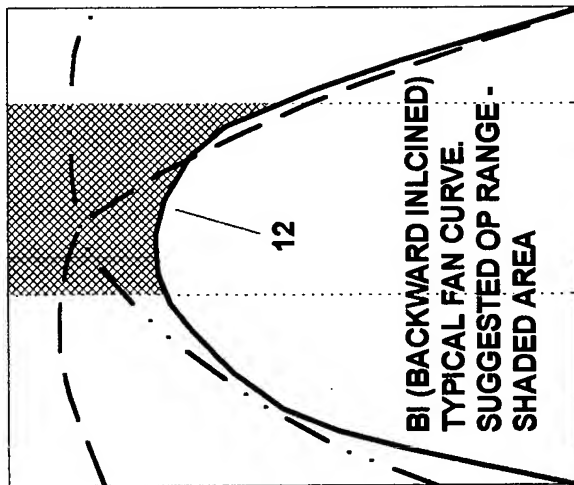
FIG. 5

SP — — — — —
 STATIC EFF. — — — — —
 BHP

SP CURVE OCCURS AT
 SPECIFIED FRPM AND IS THE
 BASIS FOR DETERMINING OP
 WHEN PLOTTED AGAINST
 A GIVEN SYSTEM.

NEW METHOD SHALL FURTHER
 BREAK DOWN THIS CURVE INTO
 THE THREE KEY COMPONENTS
 FOR ANALYSIS: SP, VP, TP

THIS WILL ALSO PROVIDE
 THE BEST MEANS OF PAIRING A
 PRIME MOVER AND ITS
 SYSTEM FOR EQUIPMENT
 SELECTION.



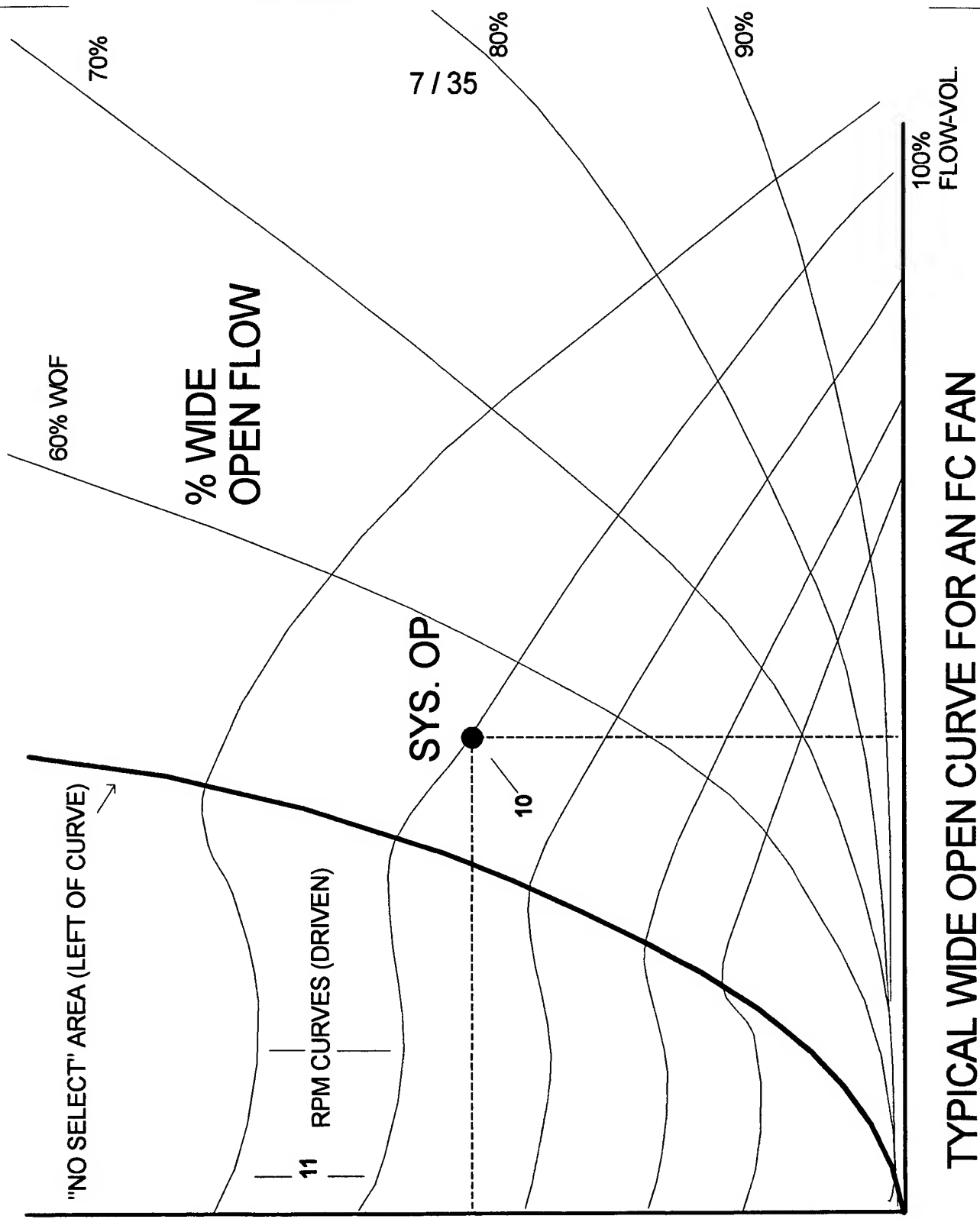


FIG. 6

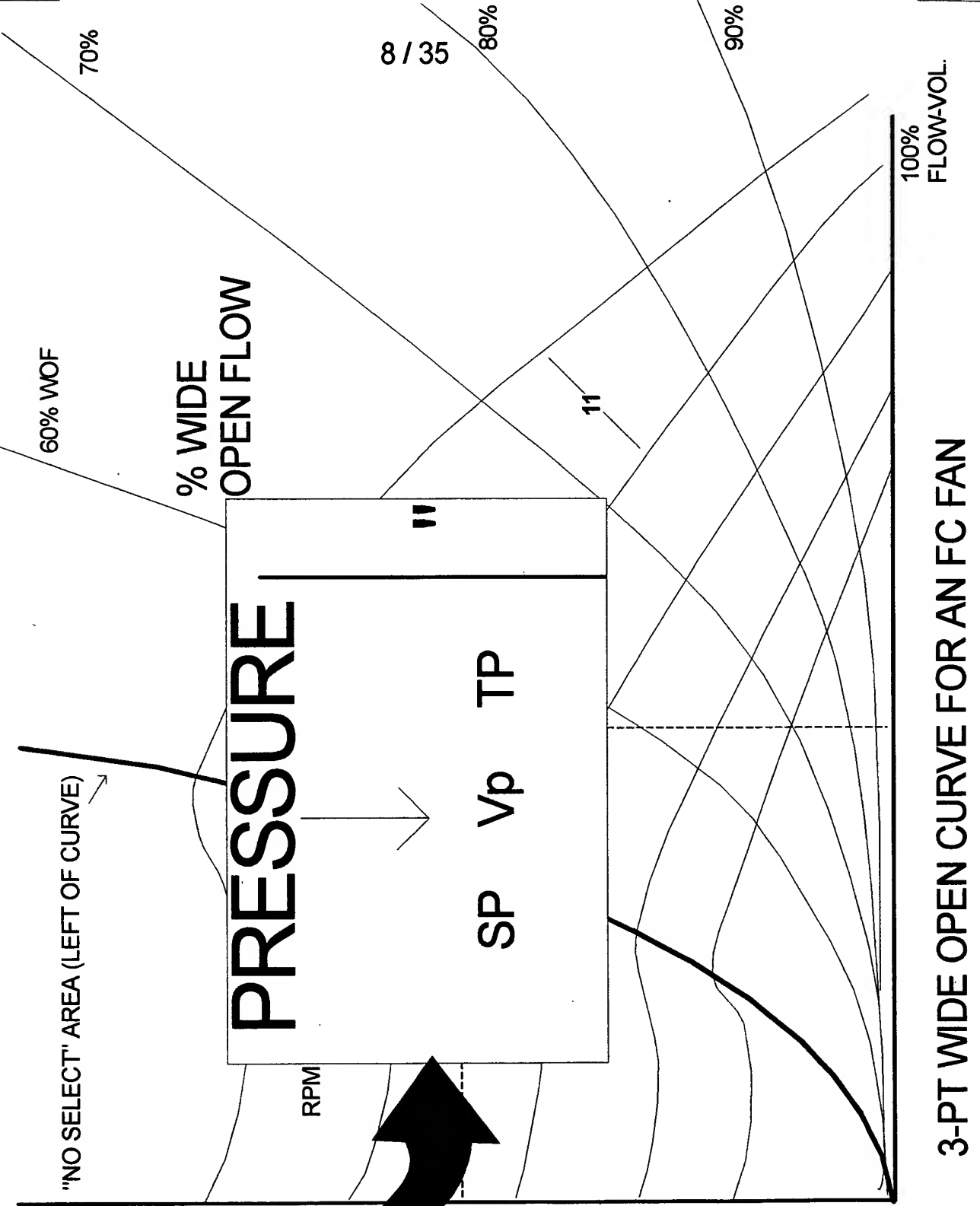
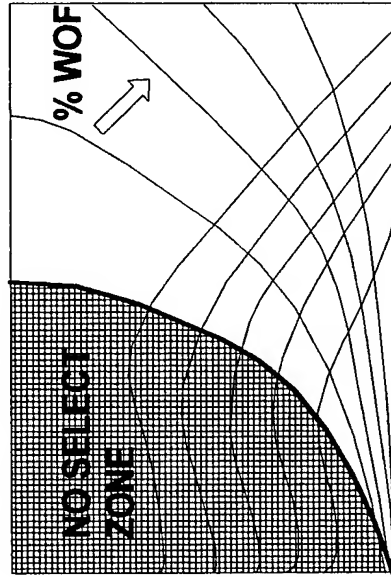


FIG. 6A

WIDE OPEN AND SYSTEM CURVES JUXTAPOSED

FIG. 7

KNOWN PRIME MOVER WOC



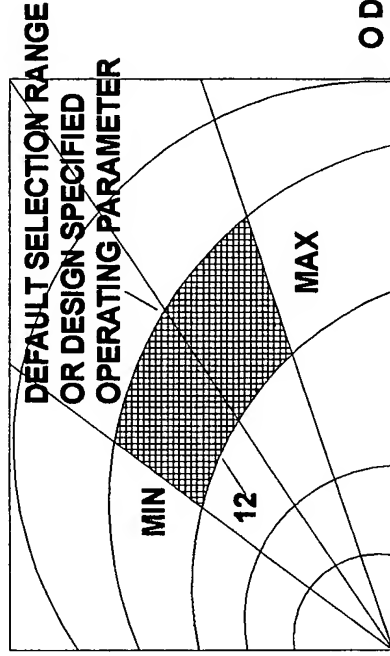
1



100%
FLOW-VOL.

FIG. 7A

TERMINAL OR IN-LINE DEVICE WOC



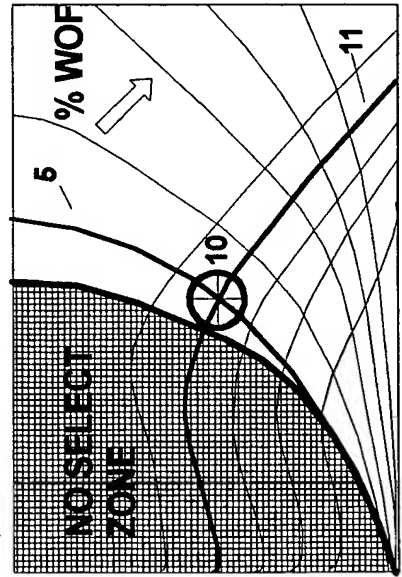
3

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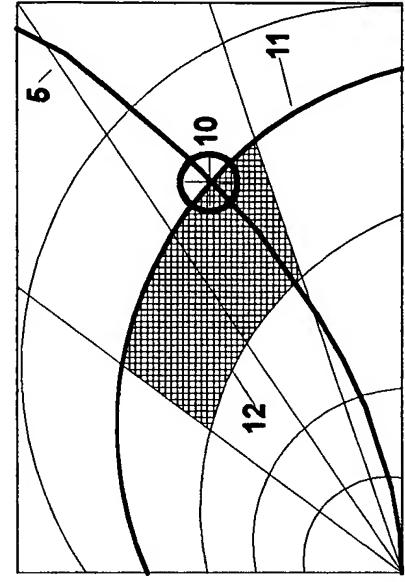


0 DEGREES OR
100% OPEN

UNKNOWN TOTAL SYSTEM ATTACHED



UNKNOWN SUB-SYSTEM ATTACHED



PRIMARY OR TERMINAL HEAT EXCHANGE

8

FIG. 8

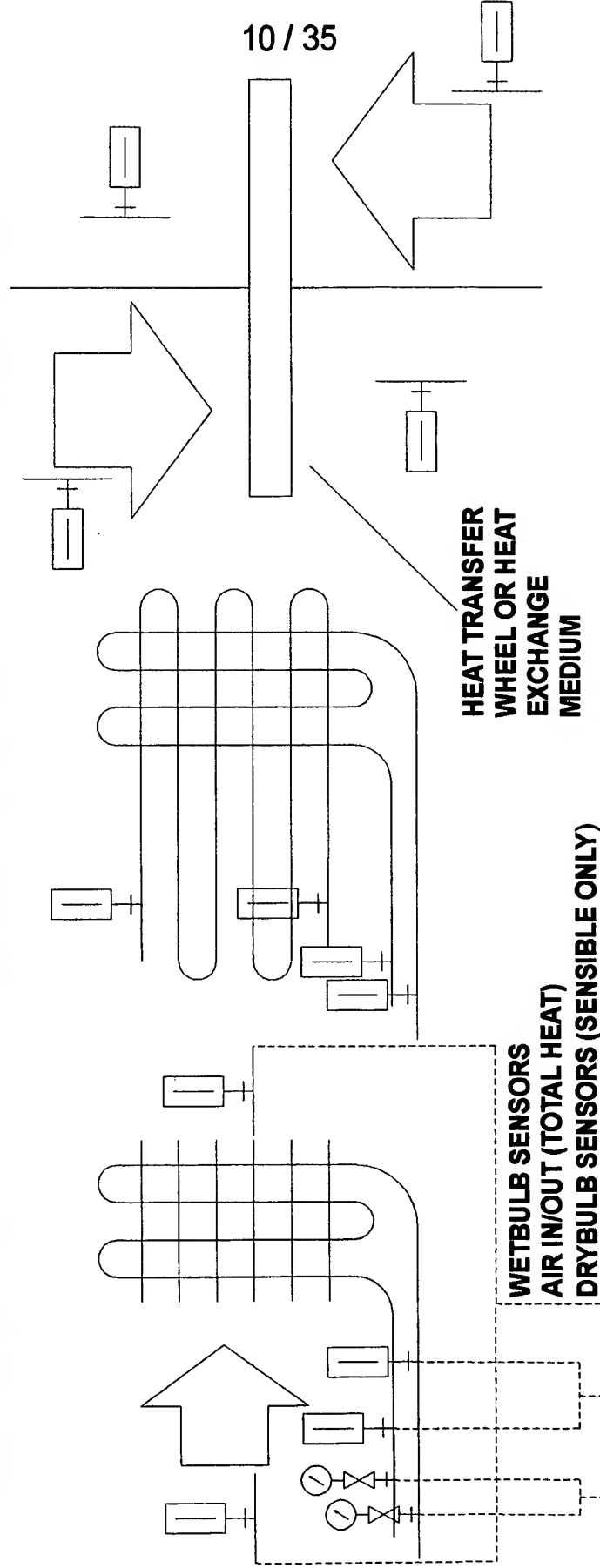
AIR TO WATER

FIG. 8A

WATER TO WATER

FIG. 8B

AIR TO AIR

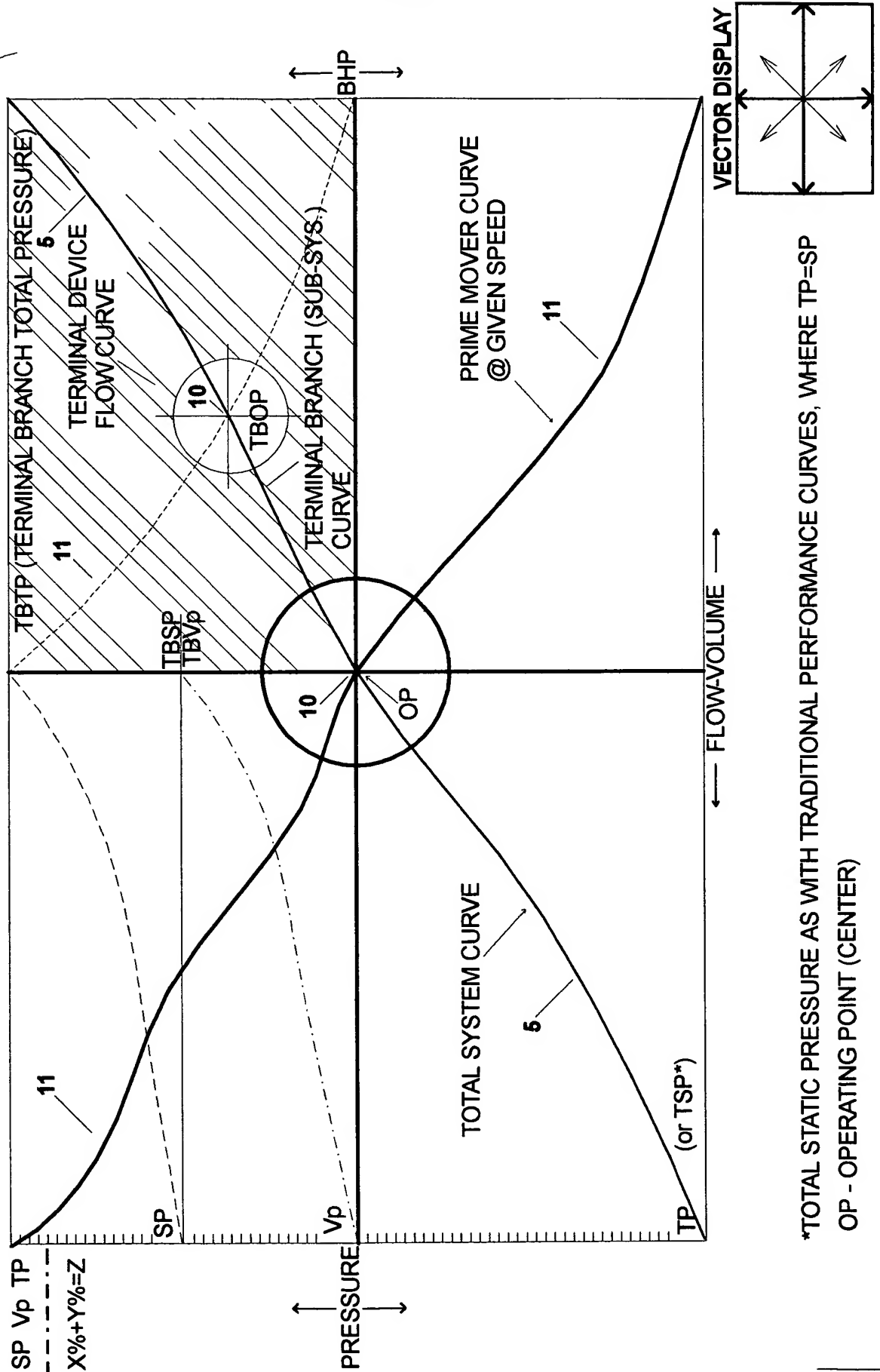


ENTERING AND LEAVING AIR
TEMPERATURES IN COUNTER
FLOW EXCHANGER

AIR-GAS-FLUIDS TO SAME
FLUIDS TO FLUIDS
GASES TO GASES
FLUIDS TO GASES, VICE VERSA
MIXTURES TO MIXTURES
(ALL OF THE ABOVE)

*VARIATIONS WOULD INCLUDE THE
FOLLOWING IN ANY ARRANGEMENT,
FORM, NUMBER, OR COMBINATION:

FIG. 9 MAIN PANEL DISPLAY



*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP
OP - OPERATING POINT (CENTER)

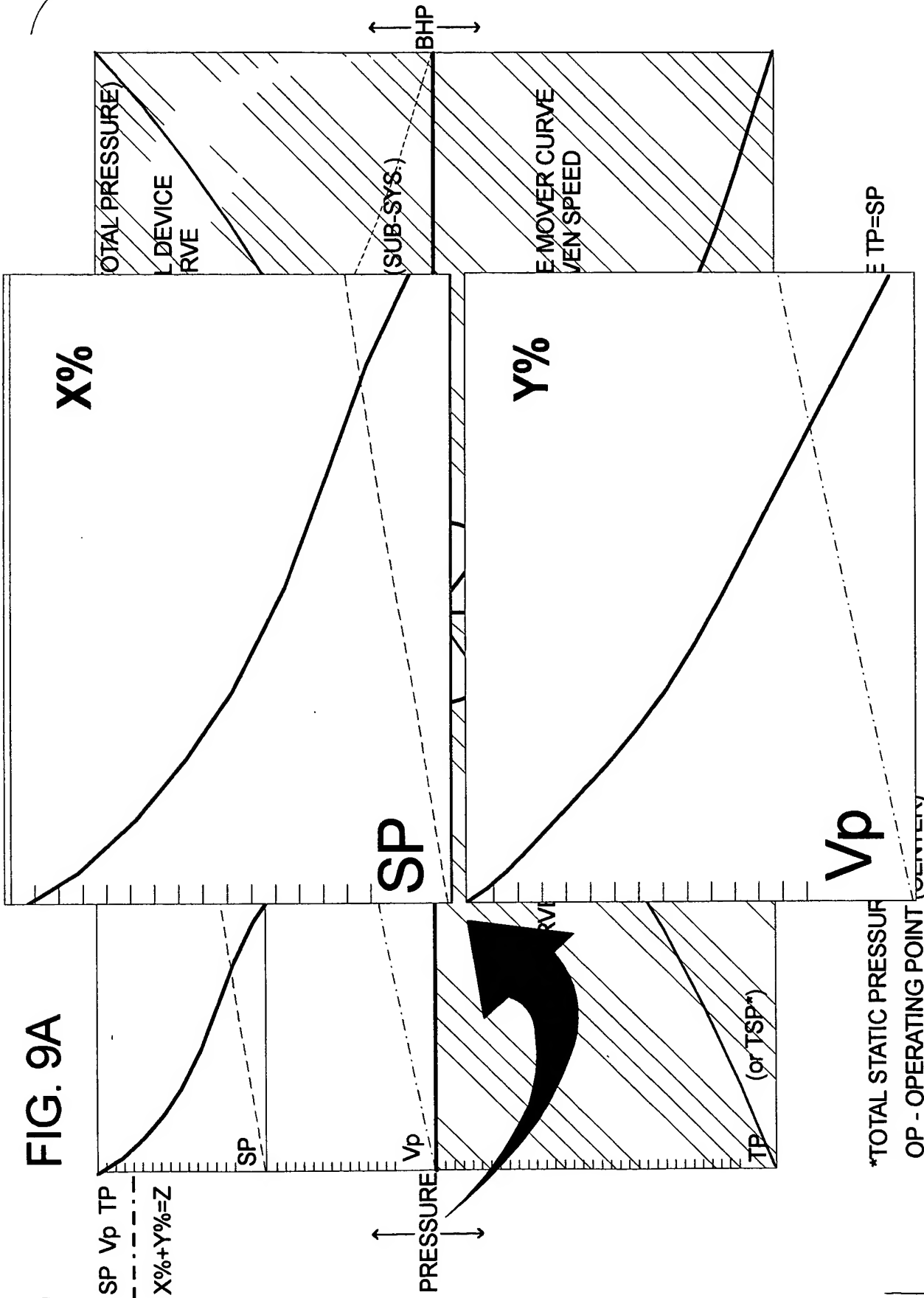
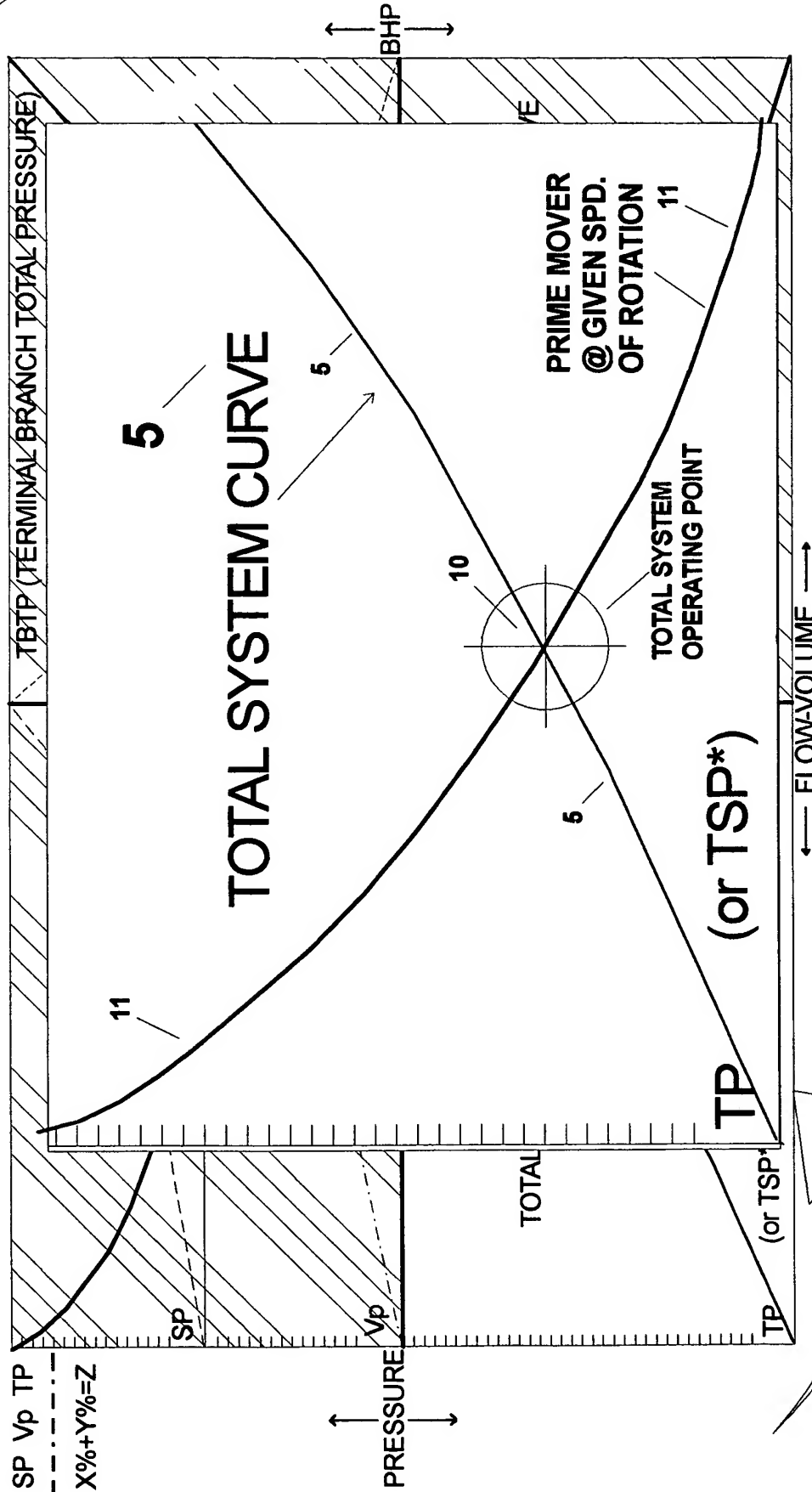


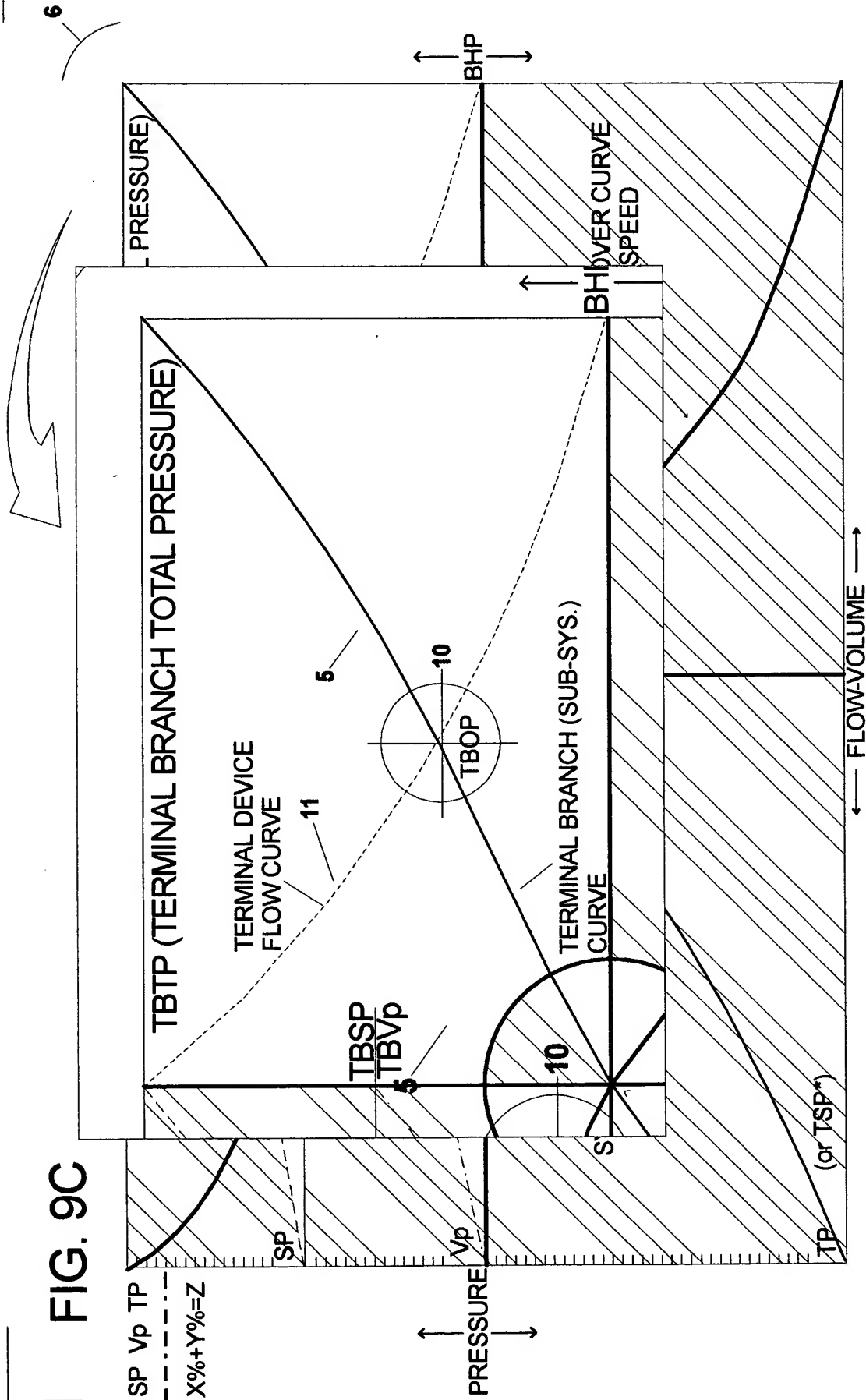
FIG. 9B



*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE $TP = SP$
 OP - OPERATING POINT (CENTER)

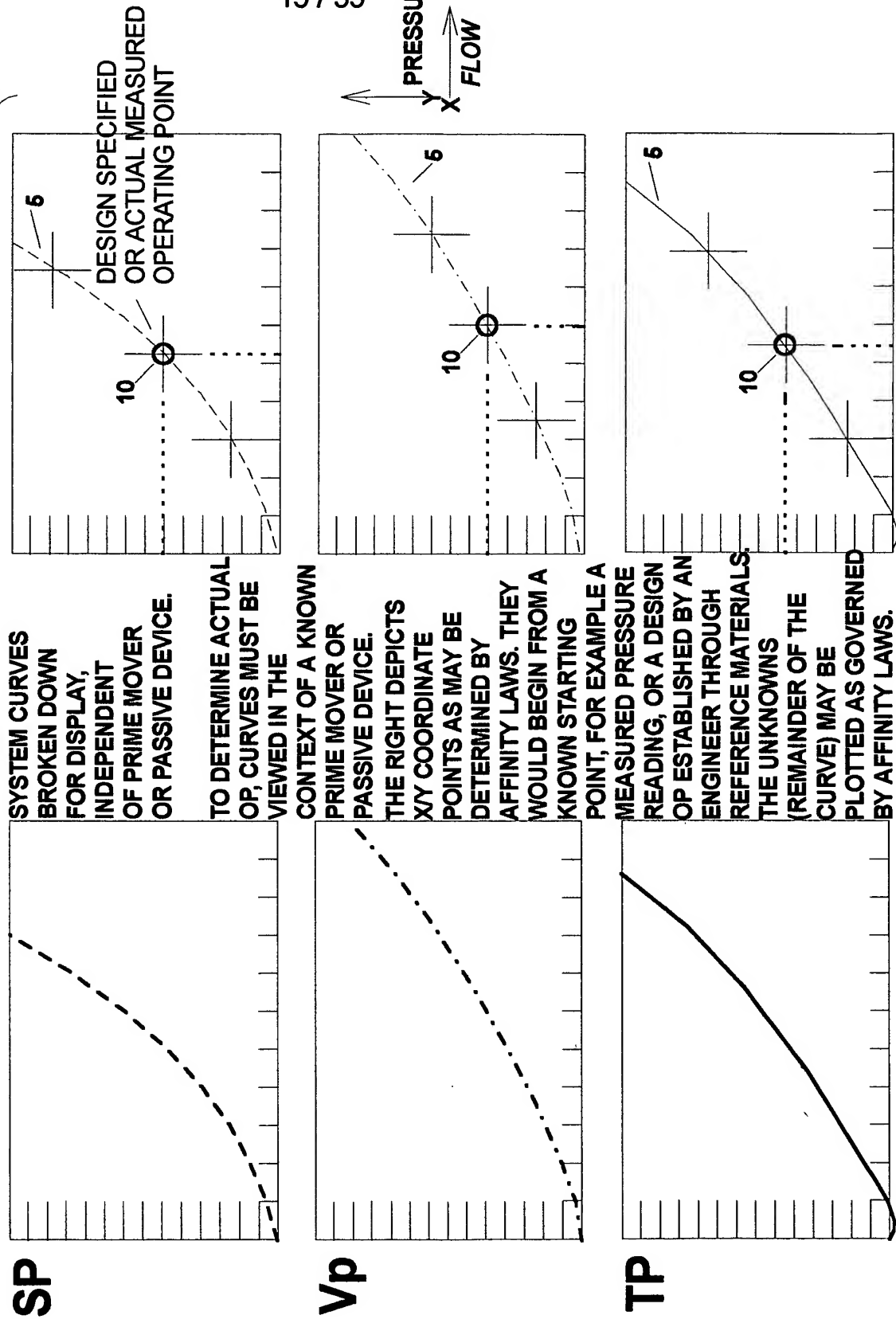
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FIG. 9C



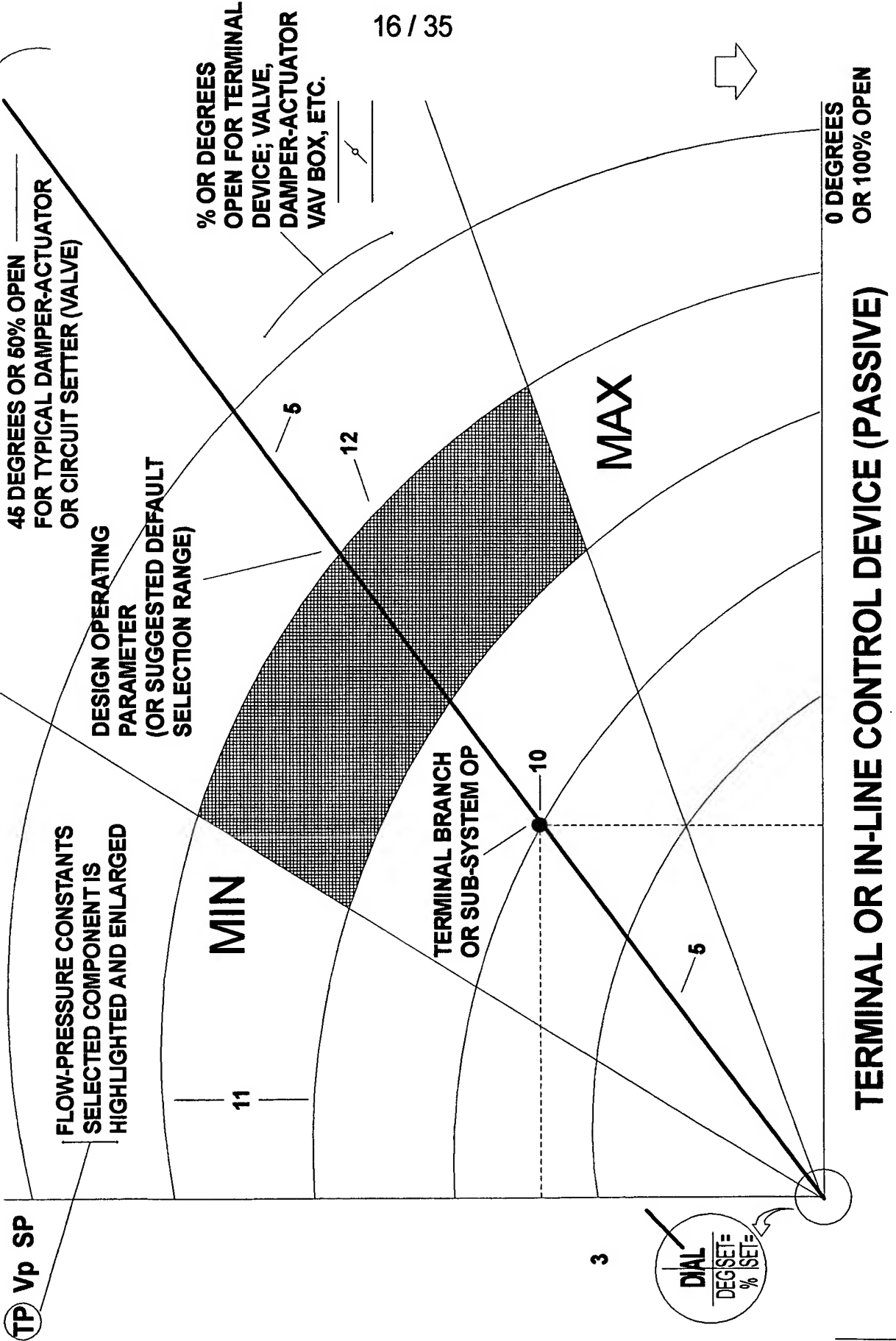
*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP
OP - OPERATING POINT (CENTER)

6.



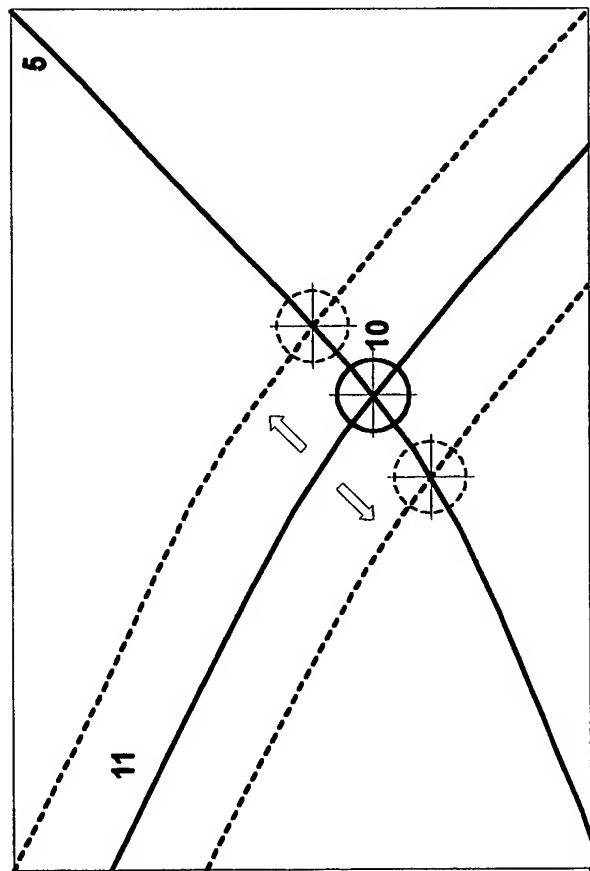
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FIG. 11 TERMINAL DEVICE (WOC) WIDE OPEN CURVE



CURVE RIDING AND OP DEVIATION

FIG. 12



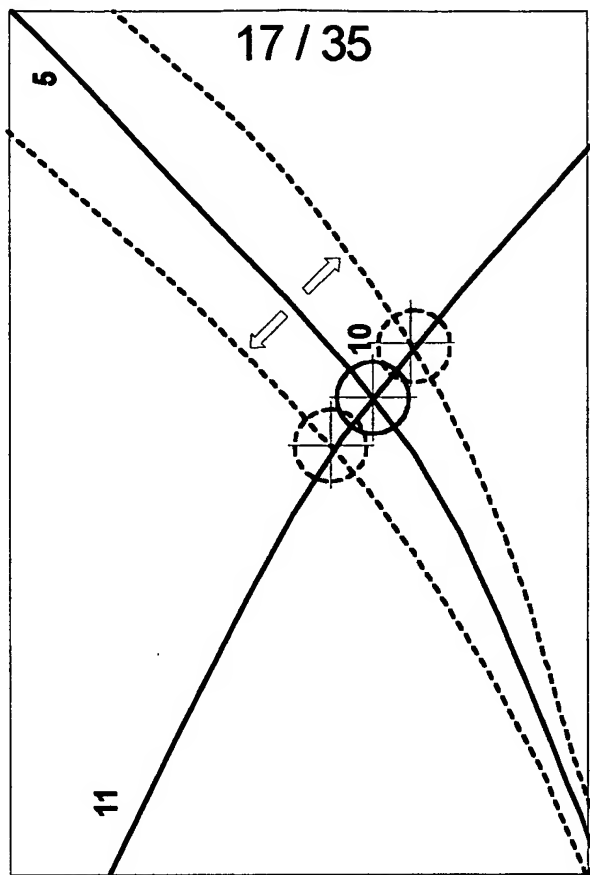
PRIME MOVER CHANGES

ROTATIONAL SPEED

SECONDARY MOVER

SERIES OR PARALLEL
OPERATION

FIG. 12A



SYSTEM CHANGES

TP SP Vp

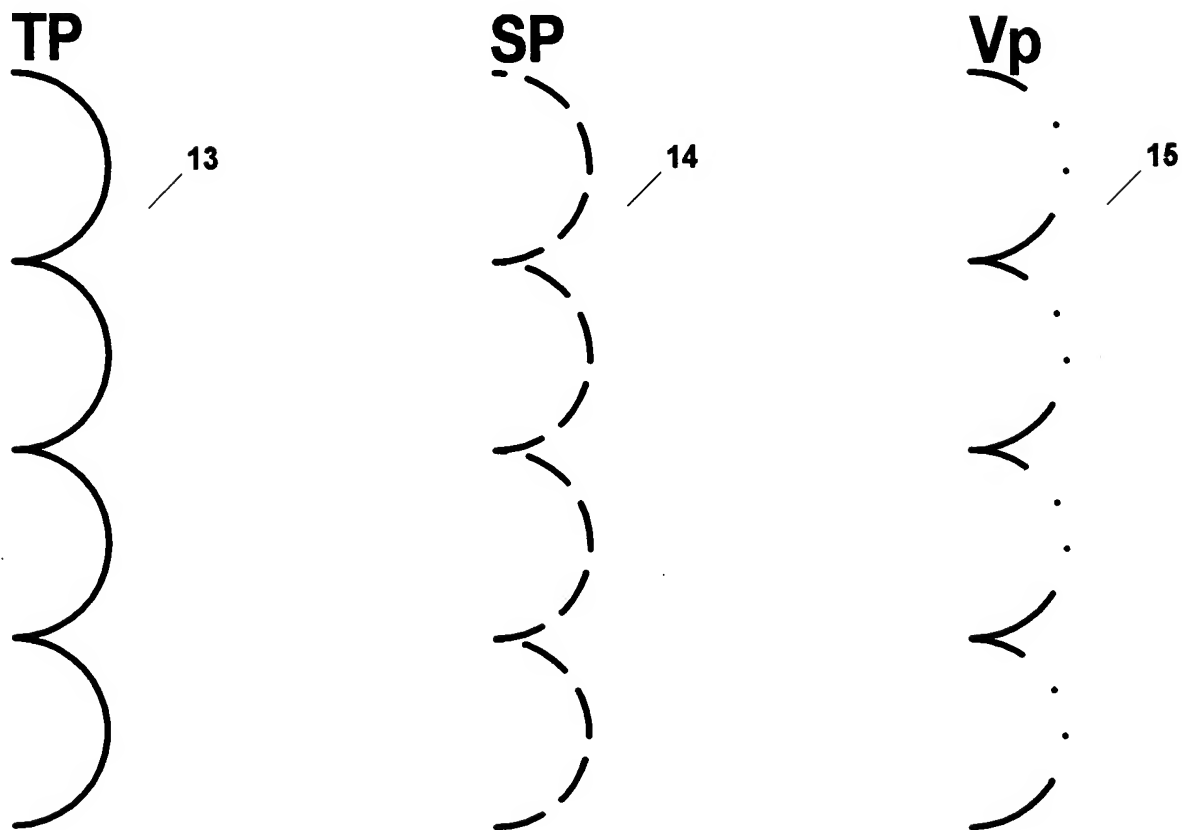
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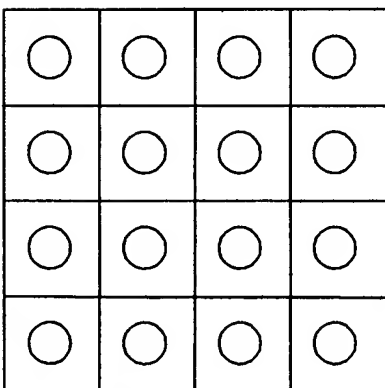
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FIG. 13

SENSOR LOGIC

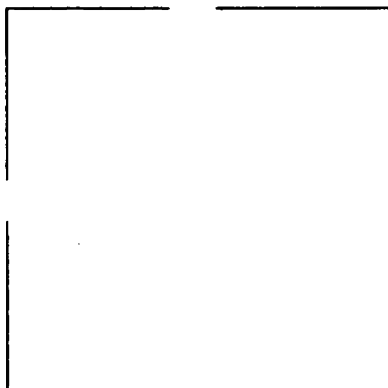


DUCT CROSS-SECTIONAL EQUAL AREA TRAVERSE



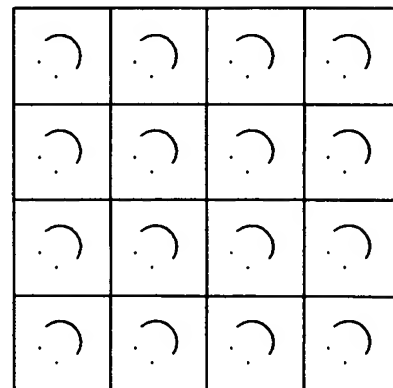
TOTAL IMPACT SENSORS

13



STATIC ONLY SENSORS

14



VELOCITY ONLY SENSORS

TP-SP, AS WITH PITOT TUBE

15

PRIME MOVER SENSOR LOGIC

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FIG. 14

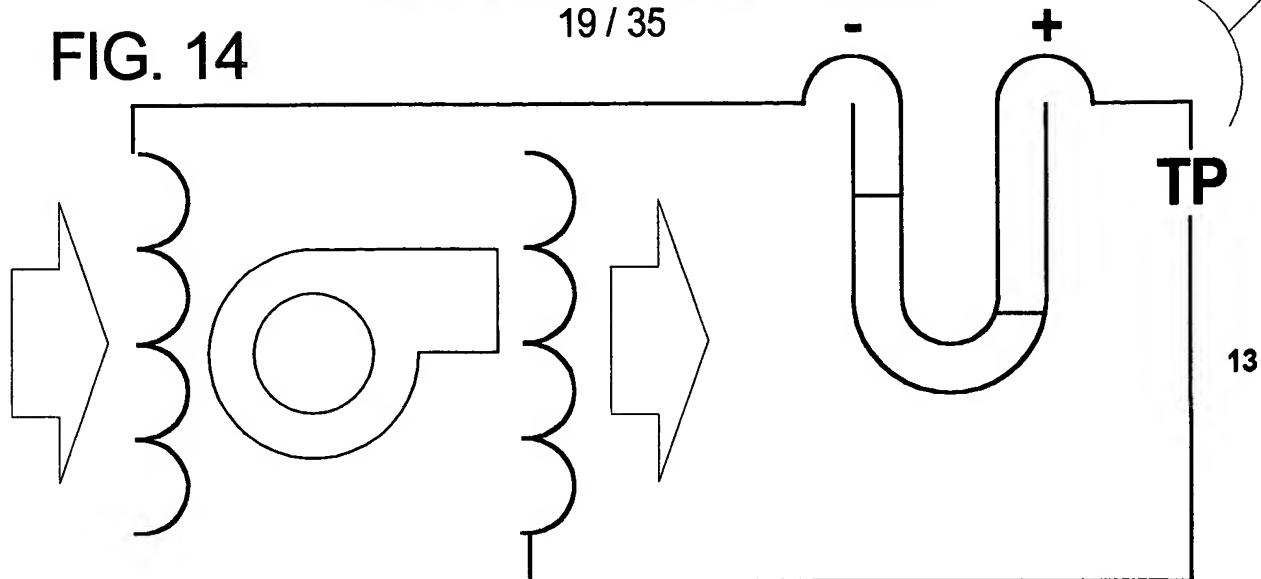


FIG. 14A

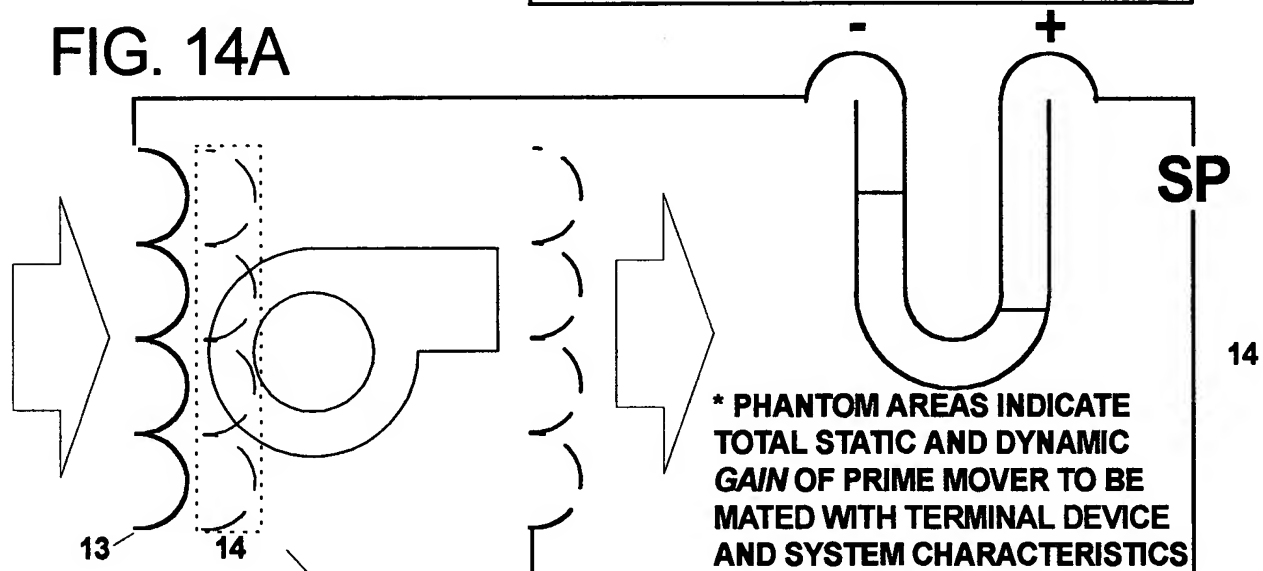
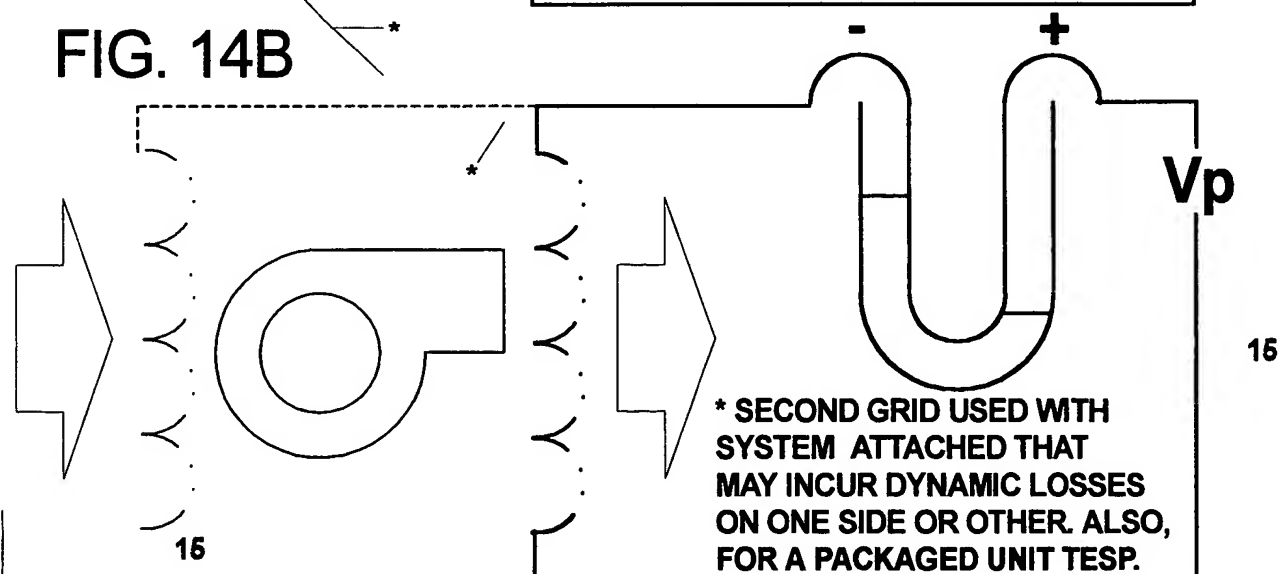


FIG. 14B

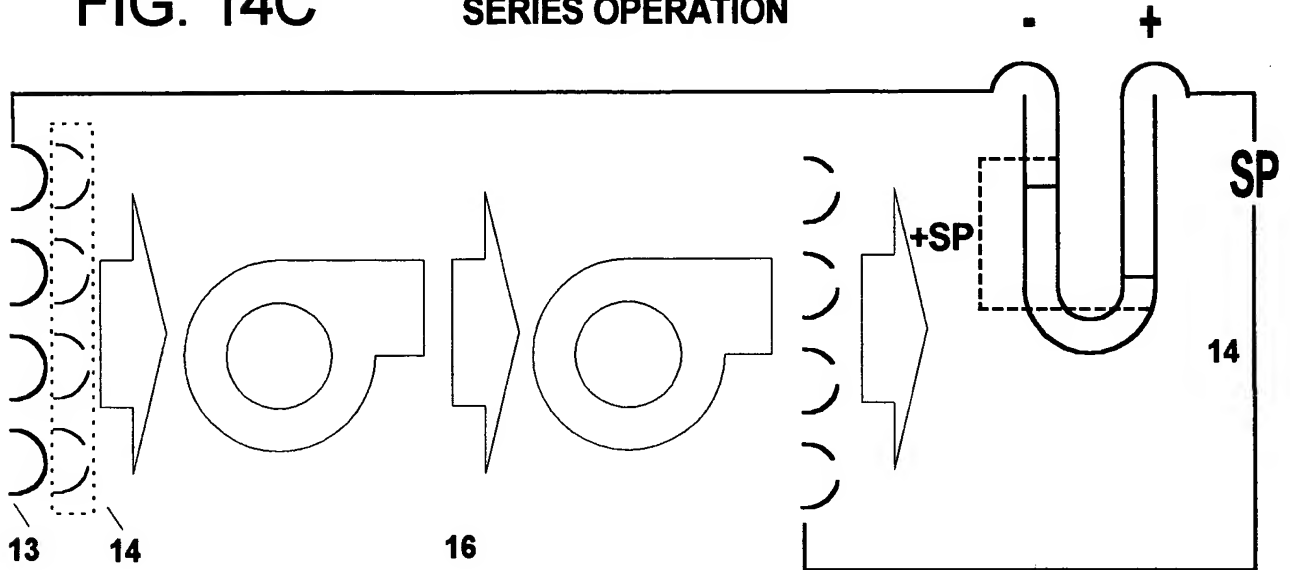


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MOVER SENSOR LOGIC IN SERIES OR PARALLEL OPERATION

FIG. 14C

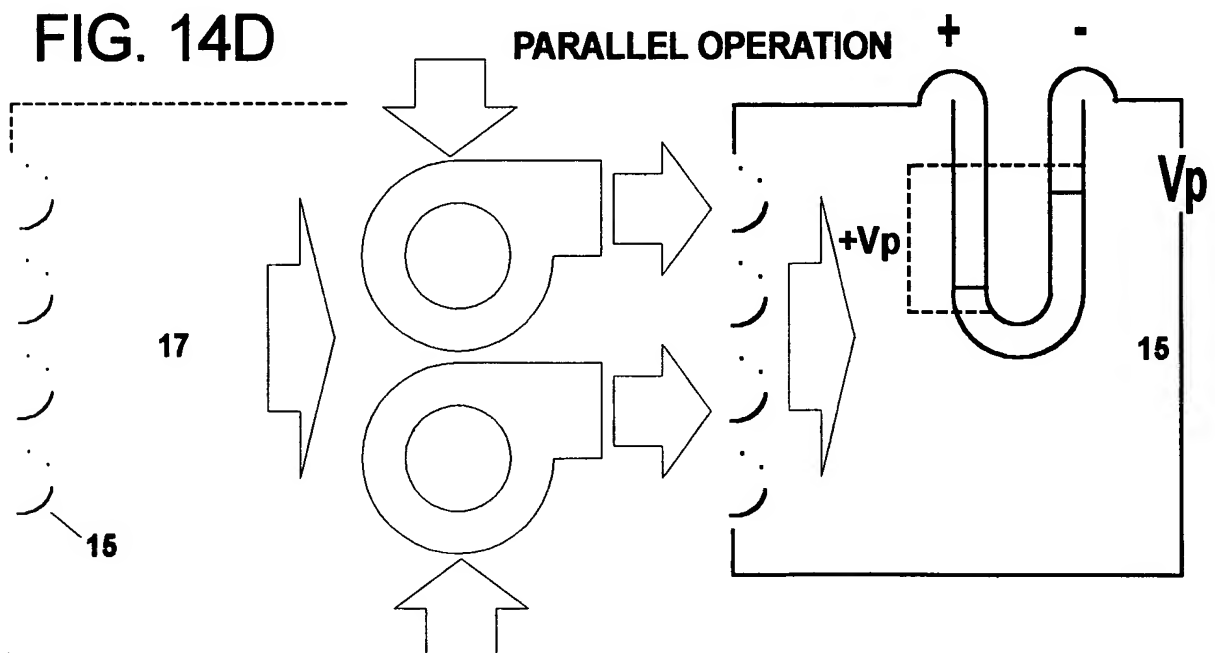
SERIES OPERATION



ONE OR MORE PRIMARY MOVERS IN SERIES OR PARALLEL
AUGMENT EITHER SP OR V_p , RESPECTIVELY, AS SHOWN.

FIG. 14D

PARALLEL OPERATION



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FIG. 15 **SENSOR LOGIC**

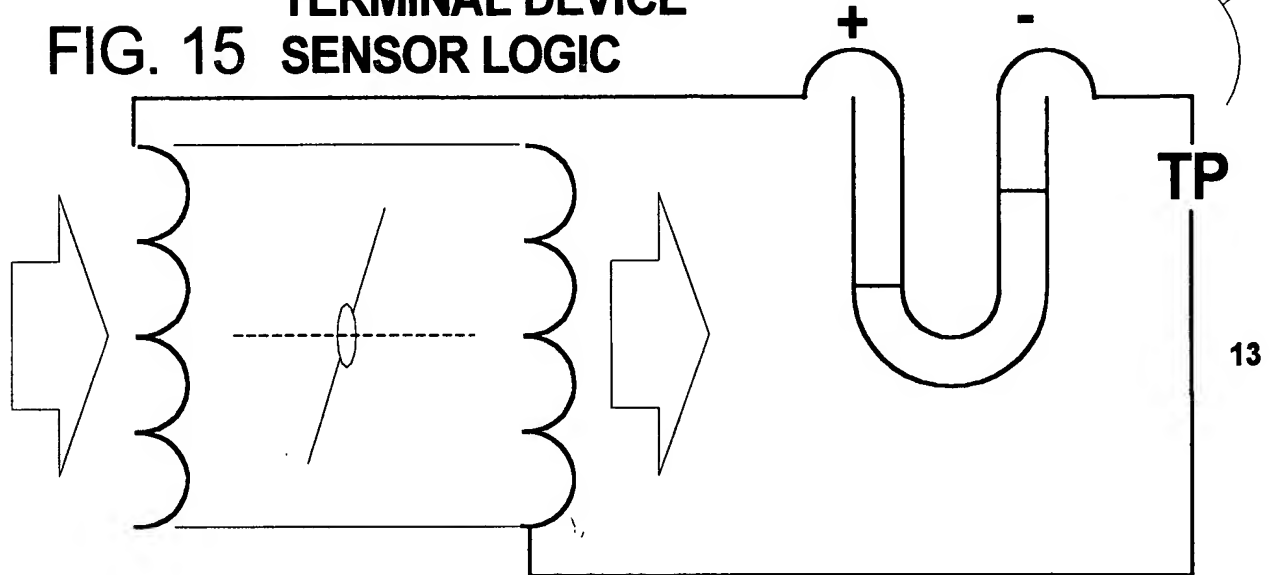


FIG. 15A

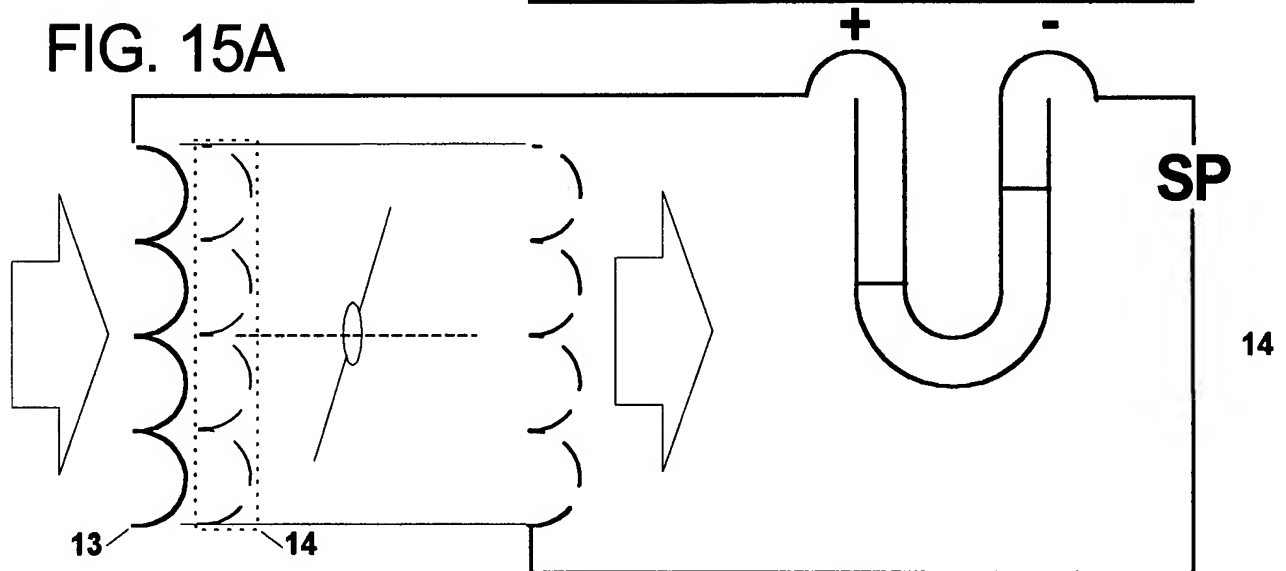
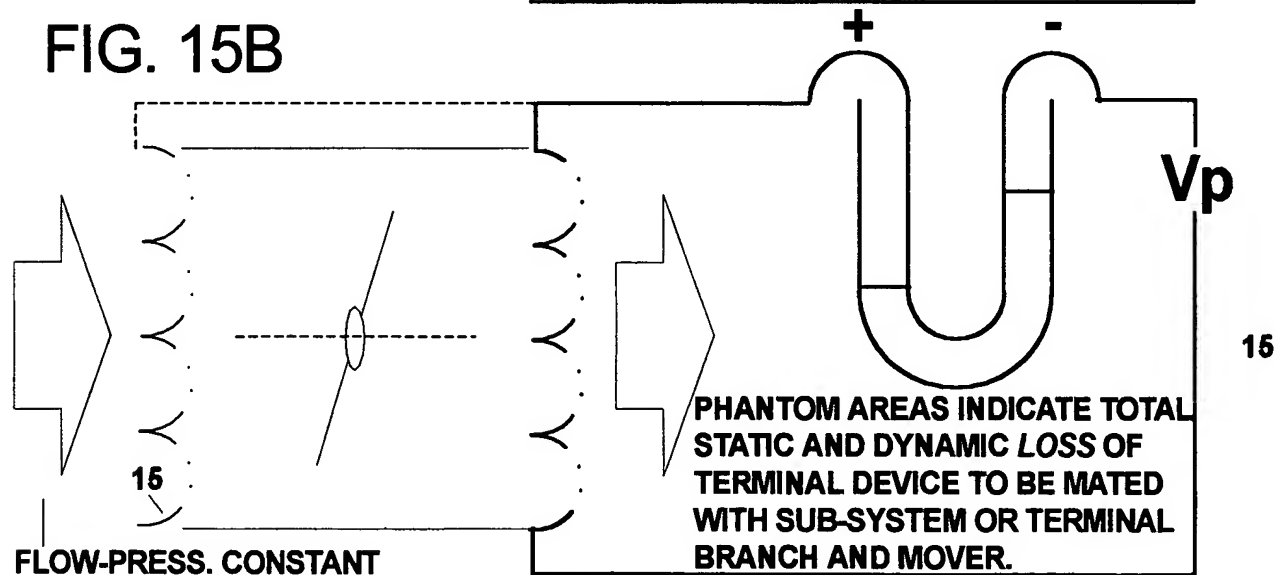


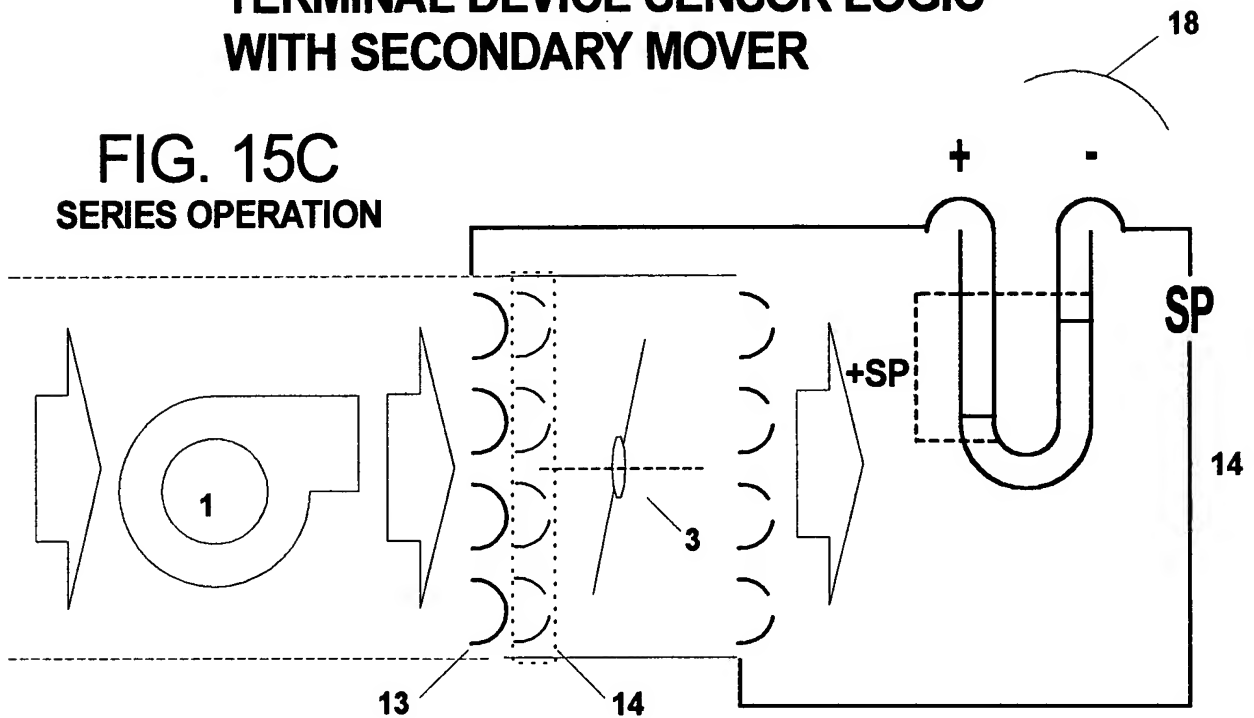
FIG. 15B



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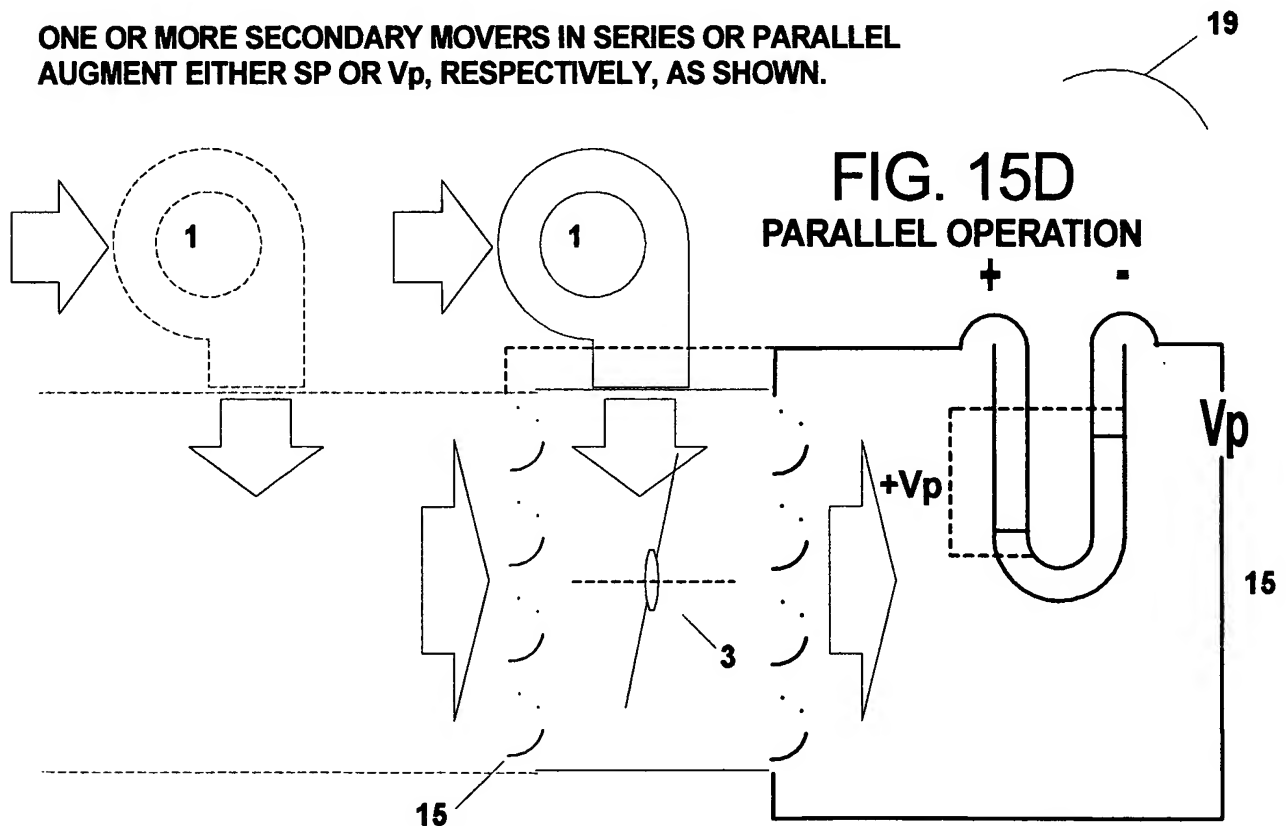
TERMINAL DEVICE SENSOR LOGIC WITH SECONDARY MOVER

FIG. 15C
SERIES OPERATION



ONE OR MORE SECONDARY MOVERS IN SERIES OR PARALLEL
AUGMENT EITHER SP OR V_p , RESPECTIVELY, AS SHOWN.

FIG. 15D
PARALLEL OPERATION

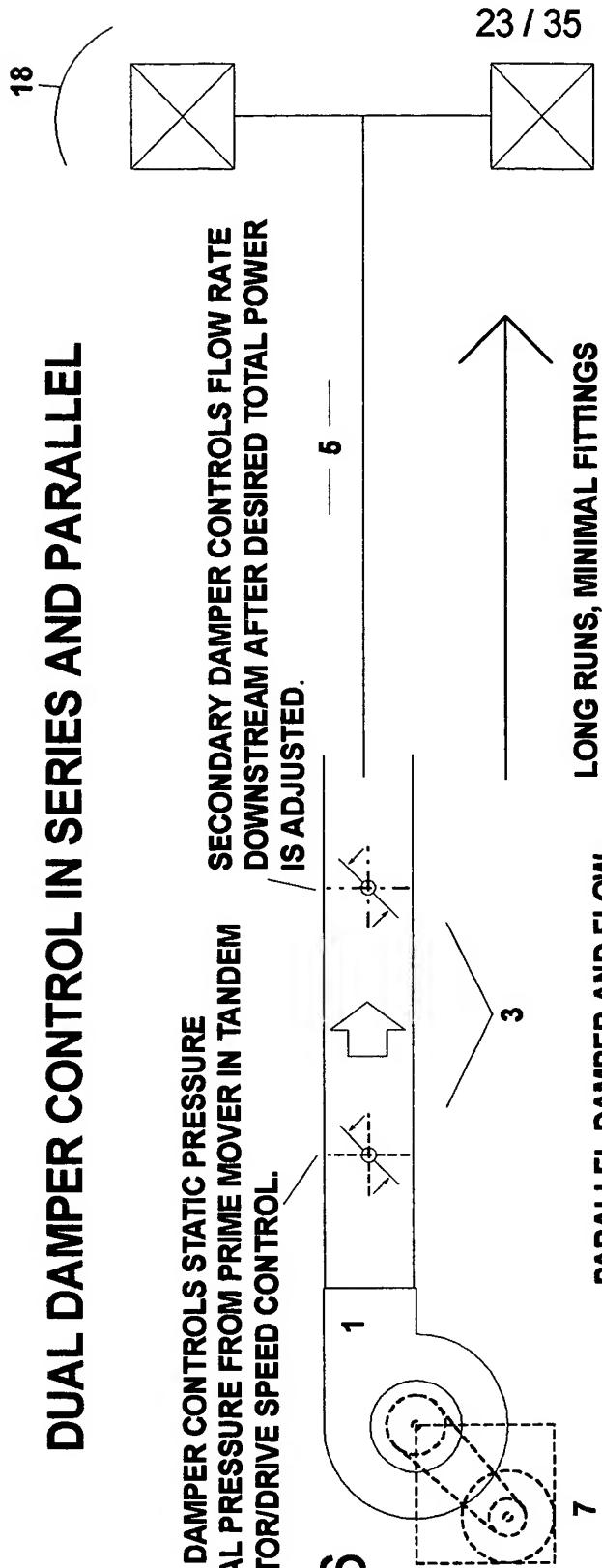


DUAL DAMPER CONTROL IN SERIES AND PARALLEL

PRIMARY DAMPER CONTROLS STATIC PRESSURE
AND TOTAL PRESSURE FROM PRIME MOVER IN TANDEM
WITH MOTOR/DRIVE SPEED CONTROL.

SECONDARY DAMPER CONTROLS FLOW RATE
DOWNSTREAM AFTER DESIRED TOTAL POWER
IS ADJUSTED.

FIG. 16

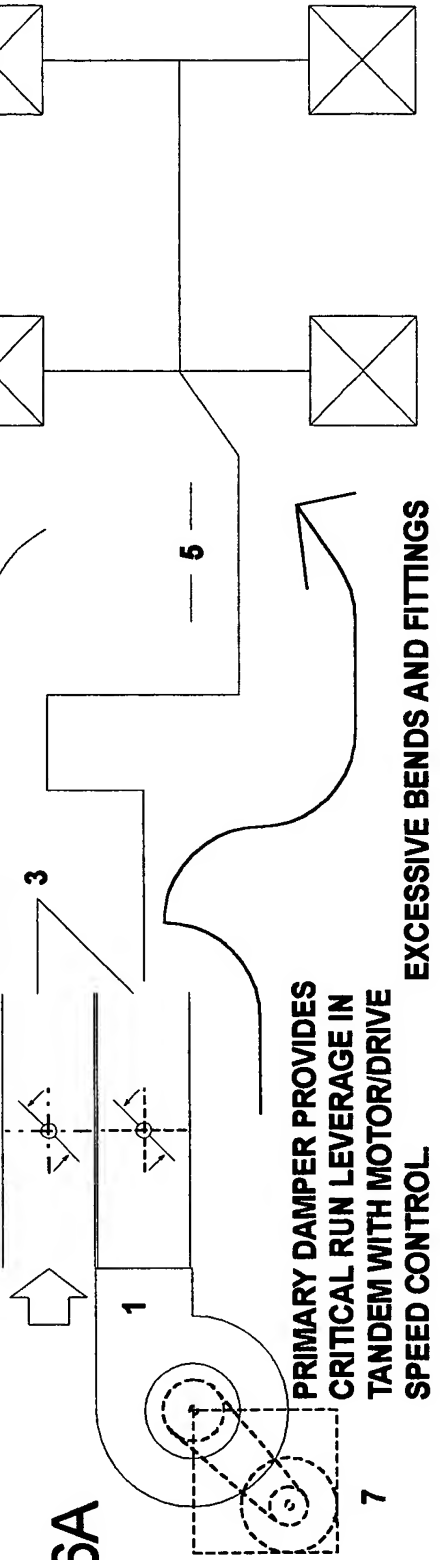


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LONG RUNS, MINIMAL FITTINGS

PARALLEL DAMPER AND FLOW
SOURCE PROVIDES CUMULATIVE
VELOCITY TO TRAVERSE FITTING
AND DIRECTIONAL LOSSES

FIG. 16A

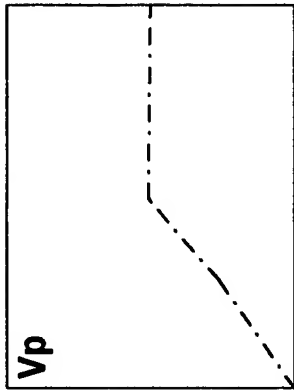
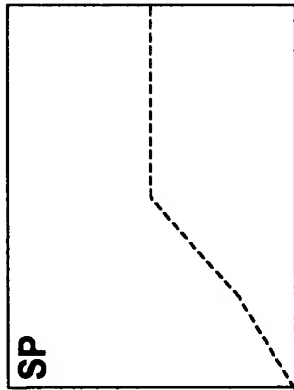


PRIMARY DAMPER PROVIDES
CRITICAL RUN LEVERAGE IN
TANDEM WITH MOTOR/DRIVE
SPEED CONTROL

EXCESSIVE BENDS AND FITTINGS

LEAKAGE TESTER

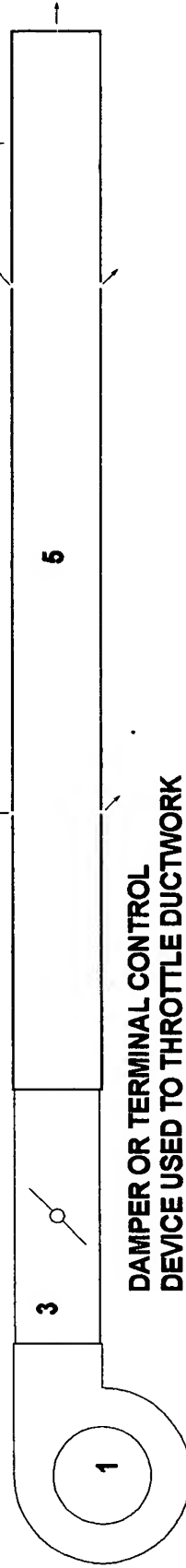
SP LEVEL ADJUSTED TO
DUCTWORK RATING TO
PERFORM STANDARD
TEST FOR GIVEN SECTION



Vp CURVE LEVEL OFF INDICATES
LEAKAGE AMOUNT PER SURFACE
AREA OF DUCT

DUCT SOX OR COMPLETELY
CAPPED MAIN SECTION.

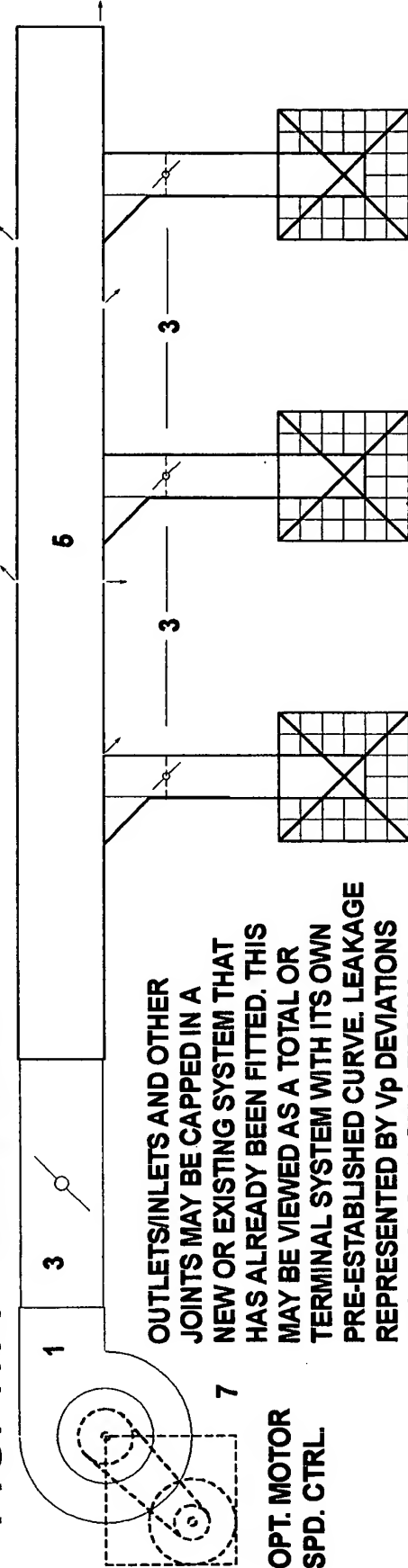
FIG. 17



DAMPER OR TERMINAL CONTROL
DEVICE USED TO THROTTLE DUCTWORK
TO ITS GIVEN PRESSURE RATING AND
MAINTAIN THIS LEVEL

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FIG. 17A



OUTLETS/INLETS AND OTHER
JOINTS MAY BE CAPPED IN A
NEW OR EXISTING SYSTEM THAT
HAS ALREADY BEEN FITTED. THIS
MAY BE VIEWED AS A TOTAL OR
TERMINAL SYSTEM WITH ITS OWN
PRE-ESTABLISHED CURVE. LEAKAGE
REPRESENTED BY Vp DEVIATIONS
(INCREASES) FROM A FIRMLY
ESTABLISHED OPERATING POINT.
SEE FIG. 12, 12A, OP DEVIATION.

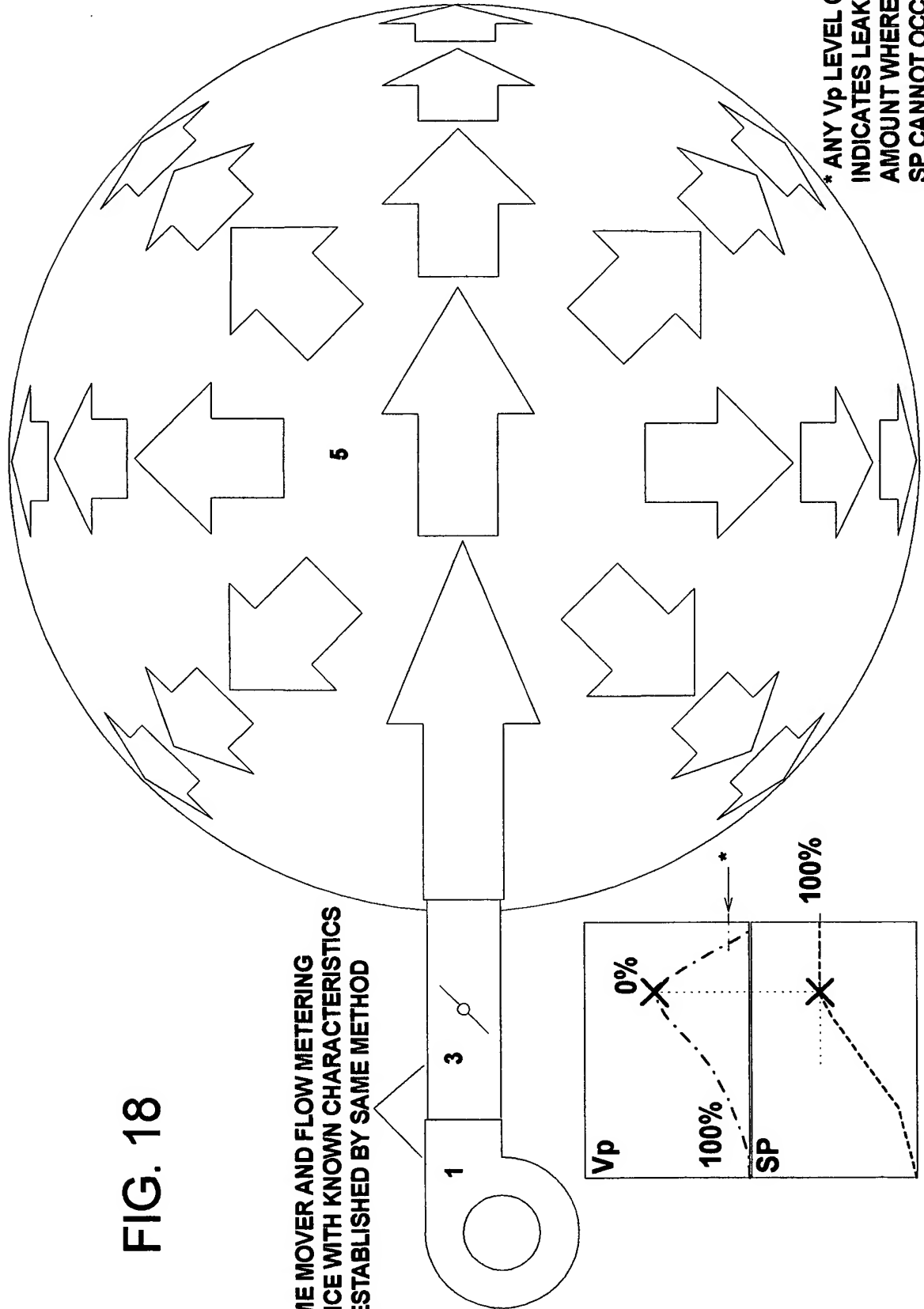
OPT. MOTOR
SPD. CTRL

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VOLUME OF A GIVEN VESSEL OR ENCLOSURE

FIG. 18

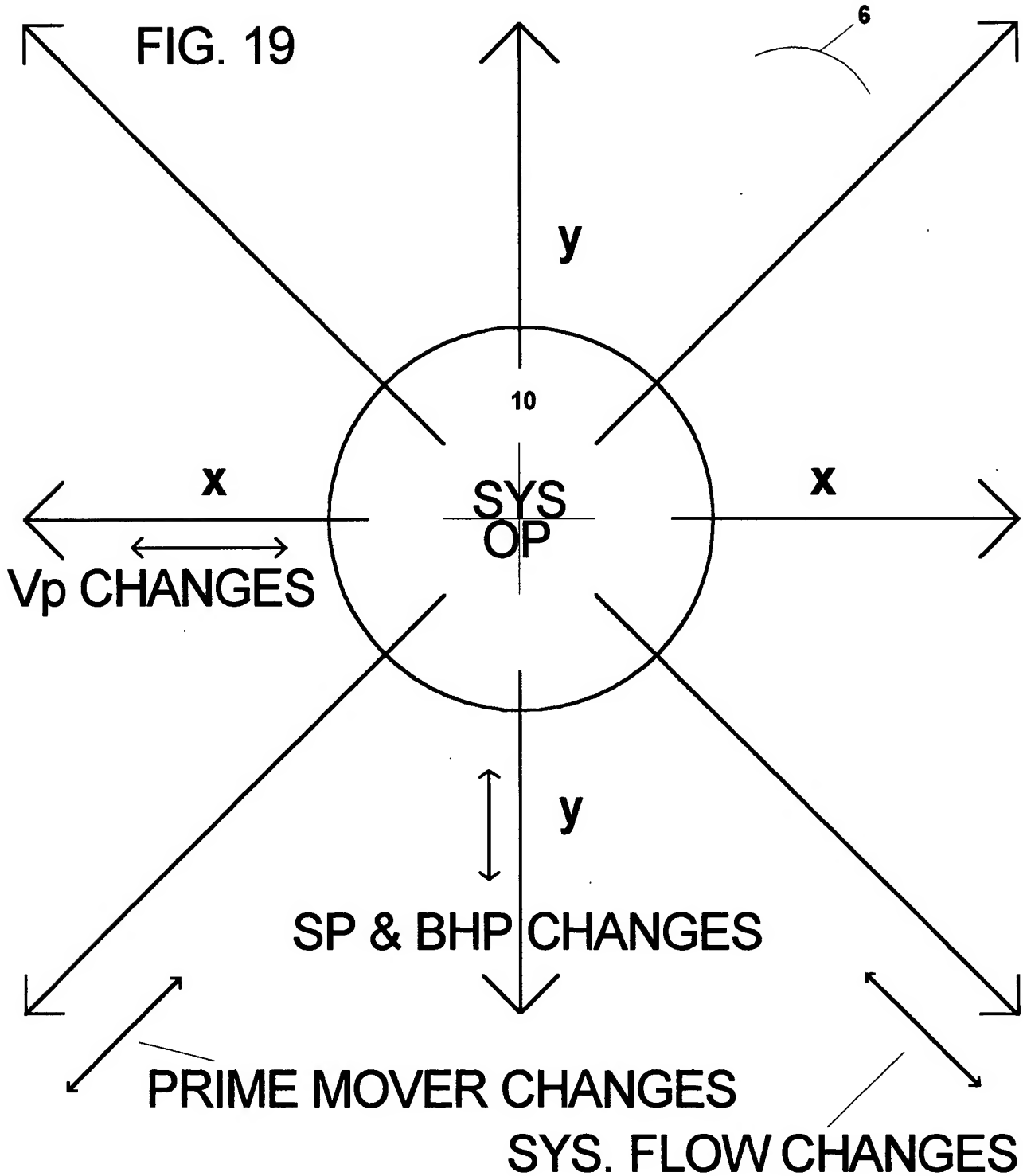
PRIME MOVER AND FLOW METERING
DEVICE WITH KNOWN CHARACTERISTICS
AS ESTABLISHED BY SAME METHOD



* ANY V_p LEVEL OFF
INDICATES LEAKAGE
AMOUNT WHERE 100%
 SP CANNOT OCCUR

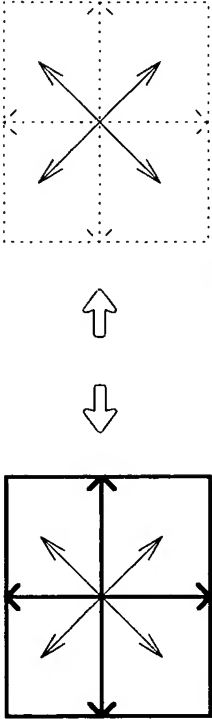
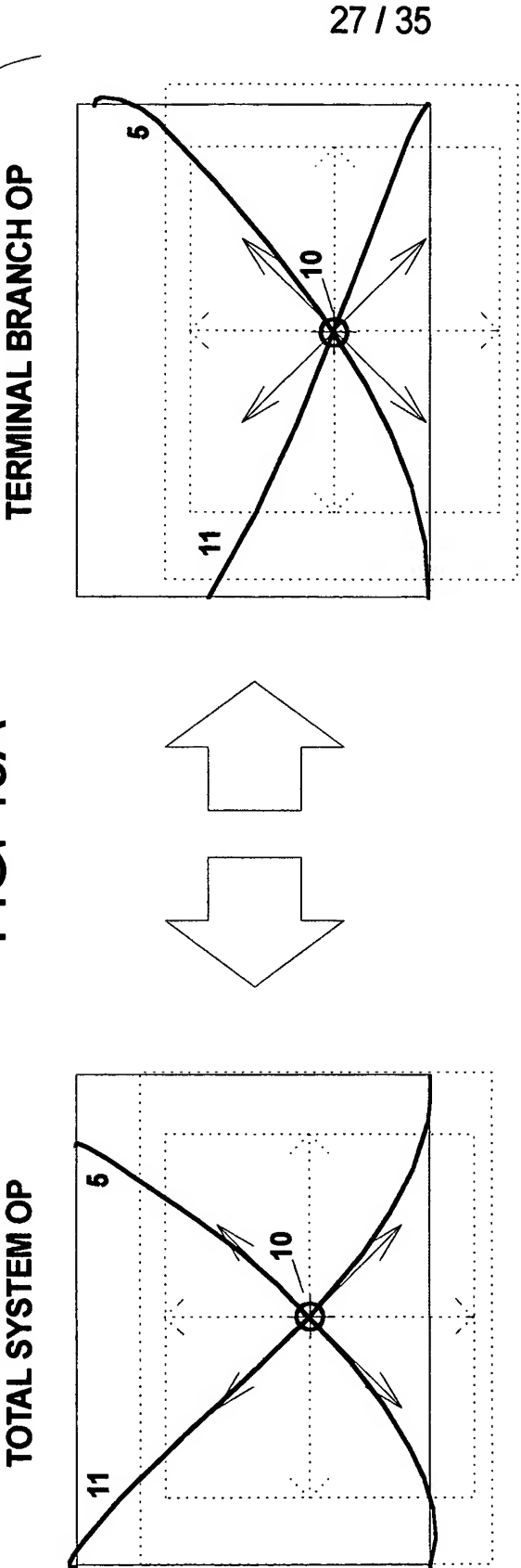
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VECTORIAL DISPLAY



VECTORIAL ANALYSIS - TOTAL SYSTEM TO SUB-SYSTEM

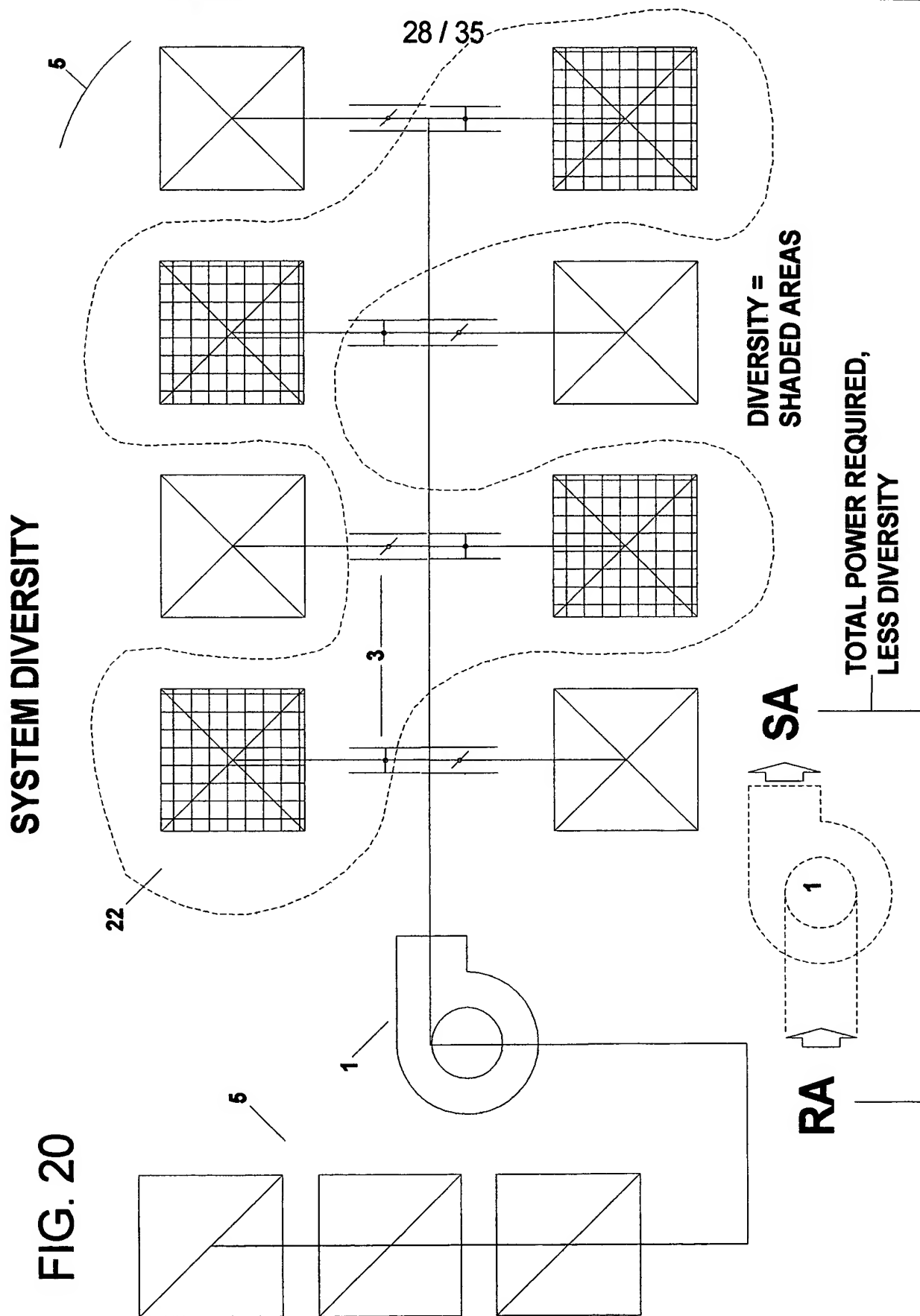
FIG. 19A



SWITCH TO OR FROM MAIN
VECTORIAL DISPLAY SCREEN
REFER TO FIG. 9

SHOWN HERE, A CORRELATIVE EFFECT
BETWEEN A TOTAL SYSTEM AND ITS SUB-
BRANCH AS THE CHANGE IN ONE AFFECTS
THE OTHER, EITHER ADVERSELY OR
BENEFICIALLY. THE VECTORIAL ANALYSIS
PROVIDES A "BARE BONES" DEPICTION OF
EACH SPECIFIC CHANGE EFFECTED IN ONE
OR THE OTHER SYSTEM. FOR EXAMPLE,
THERE WAS AN X INCREASE IN BHP
WHEN A DAMPER WAS CLOSED
IN THE SUB-BRANCH.

FIG. 20



INDEPENDENT SYSTEM CURVES (PRESSURE / HEAD)

